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Voluntary Risk disclosure Assessment in The Corporate Board Structure under uncertainty: A Case Study of Saudi Arabian Companies

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Abstract: The global crisis of financial and corporate scandals of governance have run to calls for well voluntary risk disclosure. Firms limit this disclosure of voluntary by the proprietary cost theory to evade the risk of opposing actions. So, this paper investigates and assessment voluntary risk disclosure in the corporate board structure. These voluntary risk disclosures contain the conflict and multiple criteria. So the concept of multi-criteria decision-making (MCDM) is used to overcome this problem. The neutrosophic sets are used to deal with uncertain information. This paper used the Analytic Network Process (ANP) and Decision-making trial and evaluation laboratory (DEMATEL) methods to assess voluntary risk disclosure. The ANP is used to calculate the weights of criteria. DEMATEL method is used to assess and show the impact of voluntary risk disclosure. This research uses Saudi Arabian companies as a case study.

Keywords: ANP; DEMATEL; SVNSs; Neutrosophic Sets; voluntary risk disclosure.

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1. Introduction

Mandatory disclosure is known as the corporates are needed to disclosure minimum level of information according to standards of accepted account. Mandatory disclosure includes related information about the company's performance and results of financial reporting[1]. To make an economic and financial decision, attaining the appropriate information is very important for many

stakeholders[2, 3]. Annually in companies, the financial reporting is published as a source of information for internal and externals stakeholders. Financial reporting consider as a tool of communication for moving information of non-financial and financial to attention stakeholders[3].

Corporates have become more attention to possible risks that can affect the performance of systems and sustainability in the last years due to the global crisis of finance [4]. By the review of the literature, the stakeholders obtain a little information about risks that might affect corporates. So, the investors, shareholders, and stakeholders are pressure corporates to obtain and disclose risks to help them to lessen the uncertainty in decisions and to do better management in potential risks[5]. This needs more and more information than the standards generally accepted. This is known as voluntary disclosure, which means reporting information of financial and non-financial related operations of corporates, this gives more information and explanations beyond the framework set by regulations. Eng and Mak state that "voluntary disclosure is measured by the amount and detail of non-mandatory information that is contained in the management discussion and analysis in the annual report"[6]. While mandatory disclosure regulations ensure access to basic information, voluntary disclosures should be augmented by companies[7]. The level of voluntary disclosure depends on the attitude of board members towards voluntary disclosure and the benefits and costs involved[8]. So, the voluntary disclosure information helps the users and producers for the development of the accounting standards and policies[2]. Mandatory voluntary risk disclosure includes risk information disclosed by companies as specified in the International Financial Reporting Standards (IFRS) and Saudi GAAP. Voluntary disclosure of risk is any other risk information that appears in the narrative sections of the annual corporate reports. Both of these risk types are measured by the number of risk information sentences used in the accounting literature.

Reporting of risks is important in corporate disclosure practices due to offers information and details that related to corporate investment options [9]. The previous studies found deficiencies in the disclosure of risk and vague in corporate annual reports[10]. The voluntary risk disclosure is known as "the inclusion of information about managers' estimates, judgments, reliance on market-based accounting policies such as impairment, derivative hedging, financial instruments, and fair value as well as the disclosure of concentrated operations, non-financial information about

corporations' plans, recruiting strategy, and other operational, economic, political and financial risks"[11]. So, voluntary risk disclosure is important for helping corporates to overcome uncertainties.

The capital market of Saudi Arabian is still in the stage of development with efforts to enhance its performance compared to the global capital market[12]. Moreover, though it is one of the major global oil sources, the Saudi government is investing heavily to diversify the economy by incorporating other industries including the tourism and entertainment sectors[13]. This will attract investors in local and global companies. So, the Saudi Government needs to include that corporates disclose enough information about their performance, risk vague and uncertainty. Hence, voluntary risk disclosure becomes more significant for the stability and profitability of Saudi corporates.

There are several theories that have been employed by researchers to examine how corporate board structure might influence the performance of companies. The current research employs agency theory to study the correlation between corporate board structure and level of voluntary risk disclosure in the Saudi context. Agency theory has been used by many studies to link corporate governance and voluntary risk disclosure. This theory posits that a corporate comprises of the agent and the principal. Agency theory can reduce agency loss. Agency theory advocates for the frequency of board meetings to characterize an active board of directors. Boards of directors that meet frequently are likely to result in risk reporting. Agency theory suggests that autonomous directors have no management role in the corporate, hence information concealment is minimized. Agency theory provides that presence of autonomous directors yields quality financial reports that are factual hence credible. Agency theory suggests that the characterization of corporate boards in terms of age, size, autonomy, and diversity does impact on the practice of voluntary risk disclosure

The voluntary risk disclosure more uncertain and vague information. So, this study proposed the neutrosophic sets to overcome this problem. The neutrosophic sets are generalized from fuzzy sets. Fuzzy sets cannot deal perfectly with uncertainty because not take into consideration the indeterminacy value[14]. This study proposed the single-valued neutrosophic sets (SVNSs). It is a subset of neutrosophic sets. It includes the Truth, Indeterminacy, False values (T,I,F)[15].

This kind of information includes multiple conflict criteria. So, proposed the concept of MCDM for overcoming it[16]. The MCDM method is used for assessing voluntary risk disclosure. The ANP method is used to obtaining the weights of criteria[17]. The DEMETAL is used to show impact and assessment the voluntary risk disclosure[18].

The main contributions in this work, assessment and show the impact of voluntary risk disclosure by using the neutrosophic sets to overcome uncertainty information, which not used in previous research, the ANP and DEMATAL are used as an MCDM method for assessing the voluntary risk disclosure not used in previous research and proposed a case study in Saudi Arabian companies.

The rest in this paper is organized as follow: section 2 present the review of the literature. Section 3 introduces the methodology. The case study is presented in section 4. The analysis of VRD is presented in section 5. Finally, section 5 introduces the conclusions of this work.

2. Review of Literature

Voluntary risk disclosure is an important process for corporates due to the decrease issue of inconsistent information. The benefits of voluntary risk disclosure that help in relieve issues between director's boards and stakeholders. Can decrease problems by enough information disclosing risks and uncertainties, hence the investors can acquire more and more confidence in corporate due to symmetry and consistent information[19].

Elshandidy & Neri study the impact of corporate governance on voluntary risk disclosure practices in the UK and Italy and also study the influence of those practices on market fluidity[20]. The results have many influences on organizers and investors in both the UK and Italy. Al-Maghzom et al. scout corporate governance and the demographic feature of top management teams as the determinants of voluntary risk disclosure practices in listed banks [10]. They make a case study in all Saudi Arabian banks from 2009 to 2013. The results of their study show that outer ownership, gender, audit committee meetings, profitability, the board size, and volume are primary determinants of voluntary risk disclosure practices in Saudi listed banks. Al-Janadi et al. measure and contrast the standard of voluntary disclosure practices in Saudi Arabia and the UAE by using a modified

voluntary disclosure index[21]. Their results found that the level of voluntary disclosure is low and decreases for most of the items of social and ecological information. Al-Maghzom & Abdullah address the current hole in the disclosure literature by investigating voluntary risk disclosure in a developing economy (Saudi Arabia)[22]. Habbash et al. determine the voluntary disclosure level in Saudi Arabia and identify the main drivers of voluntary disclosure in Saudi Arabia[23].

The neutrosophic sets are used to overcome the uncertainty in voluntary risk disclosure. Karabašević et al. used the neutrosophic sets to select the e-commerce development strategies[24]. Dung et al. use the interval neutrosophic sets for personnel selection[25]. Broumi et al. SVNSs to shortest path problem[26]. Akram et al used the SVNSs for the physician selection problem[27]. The MCDM is used in this paper to deal with conflict criteria. ANP and DEMATEL are MCDM methods. Yang et al. used the ANP method for calculating the weights of criteria for a novel cluster weighted[17]. Abdel-Baset et al. used the ANP method for achieving sustainable supplier selection[28]. The DEMATEL method is used to determine the degrees of impact of these criteria. Han & Deng are used the fuzzy DEMATEL method to identify the critical success factors[29]. Abdel-Basset et al. used the neutrosophic with DEMATEL method for developing supplier selection criteria[30]. Mao et al. used the DEMATEL method handling dependent evidence [31].

The review of the literature found that no study used the ANP and DEMATEL method for voluntary risk disclosure and no study used the neutrosophic sets with this kind of problem. So, this study proposed the hybrid ANP and DEMATEL method for impact and assessment of the risk closure in companies for Saudi Arabian.

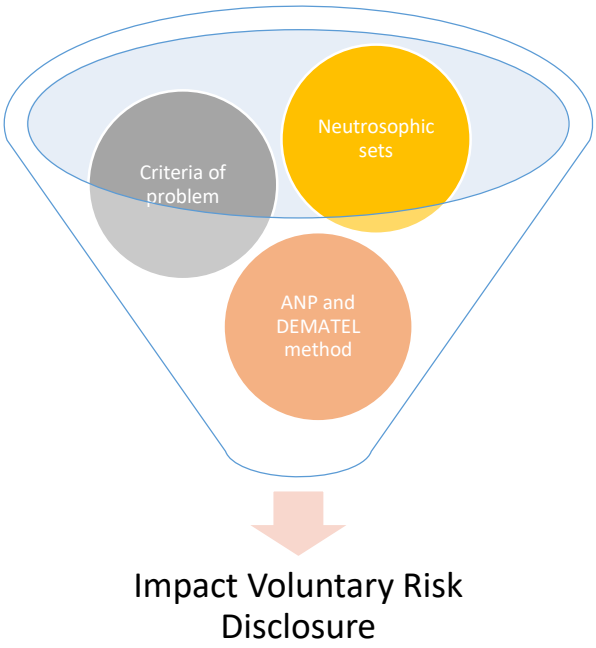

Fig 1. Research Methodology for this paper

3. Methodology

This methodology integrates the ANP and DEMATEL MCDM method under a neutrosophic environment for voluntary risk disclosure. This methodology has two-stage. In the first stage proposed the SVNSs and ANP method. ANP is used to calculate the weights of criteria. The second stage is used to show the impact and assessment of the voluntary risk disclosure. Fig 1. Show the research methodology.

3.1 First Stage ANP Method

ANP is a common MCDM method. It is modified on the AHP method. The main benefits of ANP consider dependency between elements of the problem. ANP is used to calculate the weights of criteria.

Words are described semantic better than numbers. This paper used the SVNSs as a linguistic variable. Table 1. present the single-valued neutrosophic numbers (SVNNs) and linguistic variables[15]. The steps of the ANP method are organized as follows [28]: Fig 2. Show the steps of the ANP method.

Step 1: Select a group of decision-makers and experts

Step 2: Collect the criteria from the review of the literature.

Step 3: Build the structure of the problem.

Step 4: Build the pairwise comparison matrix between criteria by using Eq. (1)

$$P^T = \begin{bmatrix} P_{11}^T & \cdots & P_{1b}^T \\ \vdots & \ddots & \vdots \\ P_{a1}^T & \cdots & P_{ab}^T \end{bmatrix} \quad (1)$$

Where T presents the decision-makers.

Step 5: Obtaining the crisp value.

After building the pairwise comparison matrix need to convert the three values (T,I,F) with one value by applying the score function by using Eq. (2)

$$S(P_{kl}^T) = \frac{2 + T_{kl}^T - I_{kl}^T - F_{kl}^T}{3} \quad (2)$$

Where, $T_{kl}^T - I_{kl}^T - F_{kl}^T$ presents truth, indeterminacy, and falsity of the SVNSs.

Step 6: Combine the pairwise comparison matrix

After obtaining the crisp value (one value) need to combine the opinions of decision-makers into one value by using Eq. (3).

$$P_{kl} = \frac{\sum_{T=1}^{T} P_{kl}}{T} \quad (3)$$

Step 7: Build the combined pairwise comparison matrix.

After combined the opinions of decision-makers build the combined matrix by using Eq. (4)

$$P = \begin{bmatrix} P_{11} & \cdots & P_{1l} \\ \vdots & \ddots & \vdots \\ P_{k1} & \cdots & P_{kl} \end{bmatrix} \quad (4)$$

Step 8: Calculate the weights of criteria

The weights of criteria are computed by computing the eigenvector which will be used in the building of the supermatrix of interdependences.

Step 9: Compute the weights of sub-criteria.

The weights of sub-criteria are computed by multiplying the weights of the interdependences matrix by the weights of local weight which was obtained by comparison matrix of opinions decision-makers.

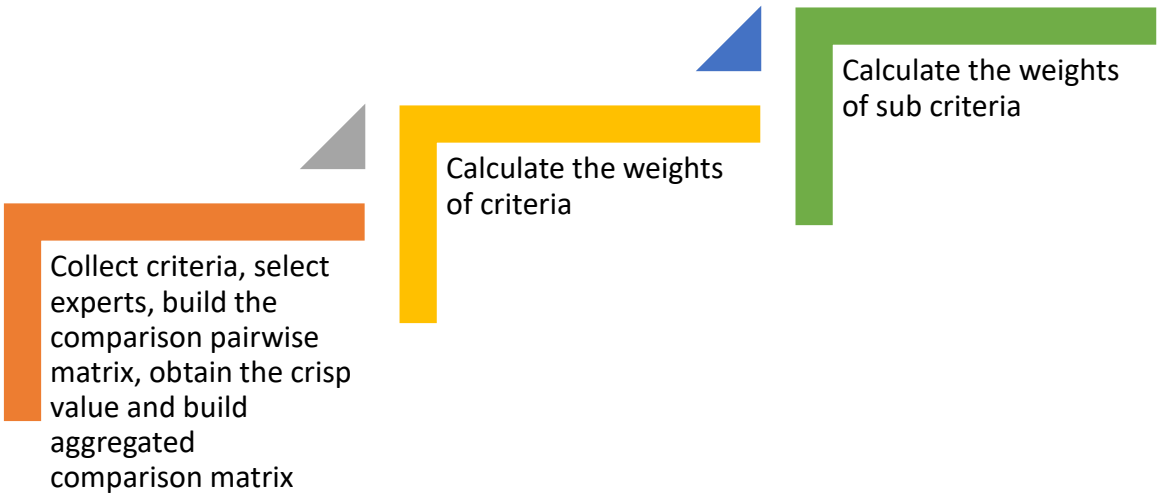

Fig 2. The steps of the ANP method

3.2. The Second Stage DEMATEL Method

The DEMATEL method is used for assessing voluntary risk disclosure and shows the impact of criteria. DEMATEL is an MCDM method. It is used to solve complex problems. The following steps of the DEMATAL method as follows [30]:

Step 10: Build the direct relation matrix.

By using the combined pairwise matrix in step 7 the direct relation matrix is built.

Step 11: Normalize the direct relation matrix.

The normalized direct relation matrix is computed by using Eqs. (5,6)

$$N = \frac{1}{\max\limits_{1\le a\le b} \sum_{b=1}^{l} P_{kl}} \quad (5)$$

$$M = N \times P \quad (6)$$

Step 12: Calculate the total relation matrix.

The total relation matrix is computed by using software Matlab to attain the identity matrix by using Eq. (7).

$$R = M(I - M)^{-1} \quad (7)$$

Step 13: Attaining the sum of rows and columns.

The sum of rows and columns is obtained as X and Y respectively. Then calculate X+Y and X-Y

Step 14: Drawing the cause and effect diagram.

The cause diagram presents in Horizontal the value of X+Y and Vertically X-Y.

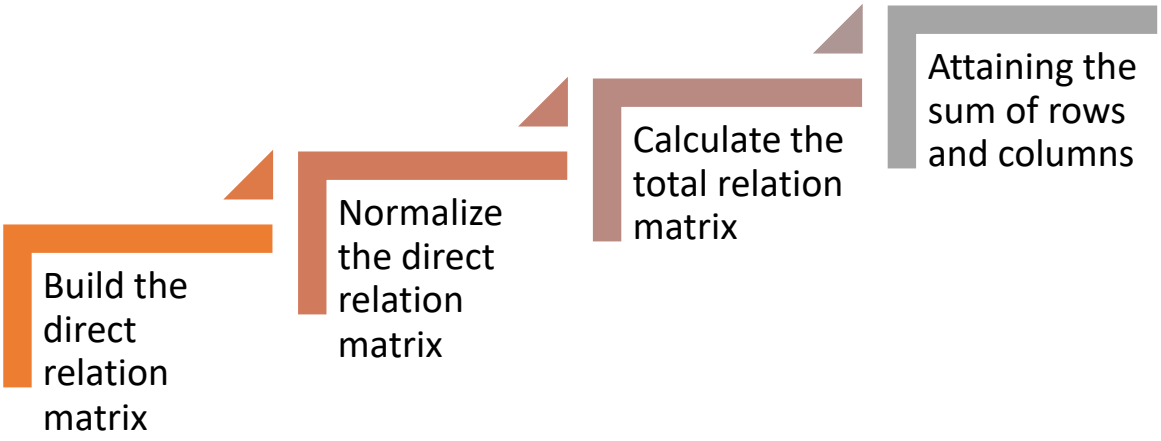

Fig 3. Show the steps of the DEMATEL method

Fig 4. The criteria of this study

4. Case Study

This study is made on companies of Saudi Arabian. The hybrid model was applied to voluntary risk disclosure. The target population of the study was all companies listed on the Saudi Stock Exchange, called Tadawul. Given the aim of this research, the sample included financial and non-financial companies. Financial institutions included banks, whereas non-financial institutions included all other listed companies. Since there are only 11 listed banks, all of them were selected and included 30 in the study. Also, out of 160 listed non-financial companies, 14 non-financial companies were randomly selected.

This study used the three decision-makers and experts to assess the criteria by their opinions. The criteria are determined from the review of the literature. The seven criteria are used in this research. Fig 4. Show the main criteria of this work. The five factors are proposed to show impact of board composition in the (voluntary risk disclosure) VRD. The five factor include: Gender F_1, Independent directors F_2, Board qualification F_3, Audit Committee meetings F_4, Board size F_5.

First by using the linguistic term in Table 1. the pairwise comparison matrix is built by opinions of experts by using Eq. (1). Then replace the linguistic term with SVNNs. Then convert the SVNNs into crisp value by score function by using Eq. (2). Then aggregate the crisp value to obtain one value instead of three values of three matrices by using Eq. (3). Then build the combined pairwise comparison matrix by using Eq. (4) to obtain one matrix. Table 2. Show the combined pairwise comparison matrix from main criteria. Tables 3 to 9 show the interdependency matrix for the main criteria. Table 10 shows the comparative for impact criteria. Fig 5. Show the weights of criteria. The weights of the criteria show that C_7 Operational Risk is the highest risk by the ANP method and C_1 Reputation Risk is the lowest risk. The rank risks in Table 11.

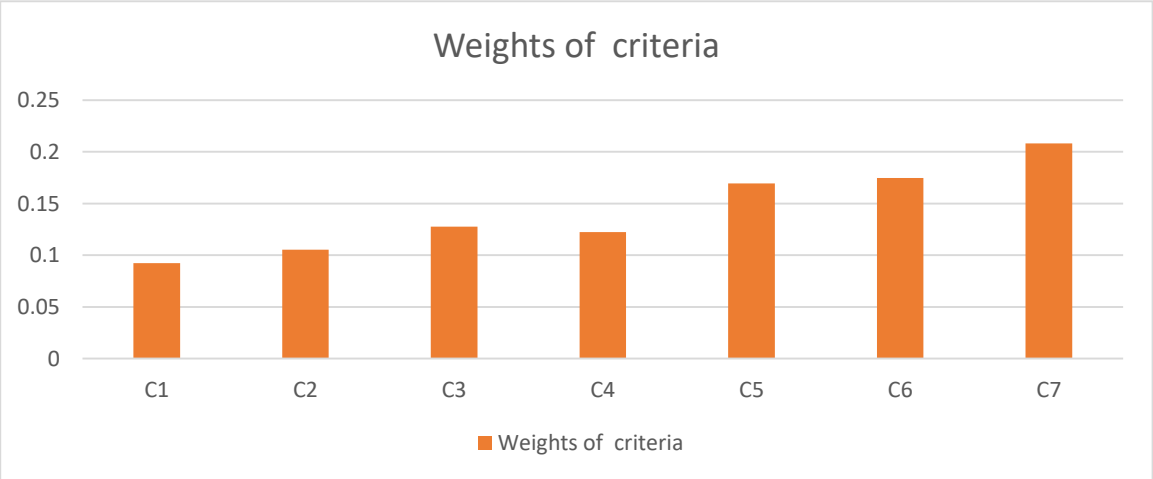

Fig 5. The weights of the criteria

Table 1. SVNSs scale.

Linguistic Term	SVNNs
Very Immoral	<0.25,0.7,0.7>
Immoral	<0.35,0.6,0.6>
Medium	<0.45,0.5,0.45>

Honest	<0.75,0.35,0.25>
Very Honest	<0.85,0.2,0.2>

Table 2. The combined pairwise comparison of criteria and local weight.

Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7	Local Weight
C_1	0.5	0.783367	0.527767	0.672233	0.750033	0.494433	0.494433	0.087967
C_2	1.281388	0.5	0.6389	0.7167	0.494433	0.672233	0.750033	0.103278
C_3	2.147428	1.742882	0.5	0.8167	0.494433	0.750033	0.3833	0.12385
C_4	1.281388	1.22444	1.22444	0.5	0.750033	0.527767	0.750033	0.121667
C_5	2.608923	2.204376	2.204376	1.338336	0.5	0.672233	0.783367	0.184447
C_6	1.281388	1.338336	1.338336	2.147428	1.685934	0.5	0.783367	0.179213
C_7	2.204376	1.338336	2.608923	1.338336	1.281388	1.281388	0.5	0.199578

Table 3. Interdependency matrix of the criteria related to C_1 Reputation Risk.

Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7	Local Weight
C_1	0.5	0.8167	0.605567	0.6389	0.750033	0.605567	0.3833	0.085857
C_2	1.22444	0.5	0.672233	0.605567	0.750033	0.494433	0.7167	0.100001
C_3	1.79983	1.685934	0.5	0.783367	0.6389	0.750033	0.672233	0.127074
C_4	2.147428	1.395284	1.281388	0.5	0.672233	0.6389	0.8167	0.139085
C_5	1.338336	1.742882	1.742882	1.685934	0.5	0.672233	0.7167	0.159205
C_6	1.395284	2.204376	1.338336	1.742882	1.685934	0.5	0.3833	0.171669
C_7	2.608923	1.395284	1.685934	1.22444	1.395284	2.608923	0.5	0.217109

Table 4. Interdependency matrix of the criteria related to C_2 Compliance Risk.

Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7	Local Weight
C_1	0.5	0.6389	0.6389	0.6389	0.6389	0.8167	0.8167	0.097589
C_2	1.742882	0.5	0.6389	0.6389	0.6389	0.750033	0.7167	0.107704
C_3	1.742882	1.742882	0.5	0.8167	0.6389	0.3833	0.527767	0.112032

C_4	1.281388	1.22444	1.22444	0.5	0.3833	0.750033	0.527767	0.10576
C_5	1.79983	1.742882	1.742882	2.608923	0.5	0.672233	0.7167	0.170402
C_6	2.147428	2.608923	2.608923	1.338336	1.685934	0.5	0.3833	0.193487
C_7	1.22444	1.395284	2.147428	2.147428	1.395284	2.608923	0.5	0.213027

Table 5. Interdependency matrix of the criteria related to C_3 Commodity.

Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7	Local Weight
C_1	0.5	0.7167	0.527767	0.6389	0.527767	0.605567	0.527767	0.084499
C_2	1.395284	0.5	0.750033	0.527767	0.750033	0.783367	0.7167	0.1109
C_3	2.147428	1.338336	0.5	0.8167	0.6389	0.527767	0.527767	0.118158
C_4	1.685934	1.22444	1.22444	0.5	0.494433	0.494433	0.672233	0.11665
C_5	1.79983	1.742882	1.742882	2.204376	0.5	0.8167	0.7167	0.173688
C_6	1.685934	2.147428	2.147428	2.204376	1.22444	0.5	0.8167	0.197791
C_7	2.147428	1.395284	2.147428	1.685934	1.395284	1.22444	0.5	0.198313

Table 6. Interdependency matrix of the criteria related to C_4 Sustainability Risk.

Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7	Local Weight
C_1	0.5	0.750033	0.672233	0.750033	0.672233	0.605567	0.527767	0.093228
C_2	1.338336	0.5	0.750033	0.6389	0.6389	0.783367	0.7167	0.109671
C_3	1.685934	1.338336	0.5	0.783367	0.6389	0.605567	0.783367	0.122658
C_4	1.685934	1.281388	1.281388	0.5	0.494433	0.494433	0.672233	0.120819
C_5	2.204376	1.742882	1.742882	2.204376	0.5	0.783367	0.7167	0.180828
C_6	1.338336	1.79983	1.79983	2.204376	1.281388	0.5	0.8167	0.18619
C_7	2.147428	1.395284	1.281388	1.685934	1.395284	1.22444	0.5	0.186606

Table 7. Interdependency matrix of the main criteria related to C_5 Technological Risk.

Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7	Local Weight
C_1	0.5	0.750033	0.6389	0.6389	0.783367	0.527767	0.527767	0.0899

C_2	1.338336	0.5	0.527767	0.6389	0.6389	0.783367	0.7167	0.104511
C_3	1.742882	2.147428	0.5	0.783367	0.6389	0.6389	0.6389	0.130527
C_4	1.685934	1.281388	1.281388	0.5	0.3833	0.605567	0.6389	0.118516
C_5	1.685934	1.742882	1.742882	2.608923	0.5	0.783367	0.7167	0.177868
C_6	1.281388	1.742882	1.742882	1.79983	1.281388	0.5	0.527767	0.165805
C_7	2.147428	1.395284	1.742882	1.742882	1.395284	2.147428	0.5	0.212873

Table 8. Interdependency matrix of the main criteria related to C_6 Strategic Risk.

Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7	Local Weight
C_1	0.5	0.8167	0.605567	0.6389	0.750033	0.605567	0.672233	0.097709
C_2	1.22444	0.5	0.672233	0.6389	0.750033	0.494433	0.7167	0.103149
C_3	1.79983	1.685934	0.5	0.783367	0.6389	0.750033	0.783367	0.136629
C_4	1.685934	1.281388	1.281388	0.5	0.672233	0.6389	0.527767	0.12808
C_5	1.338336	1.742882	1.742882	1.685934	0.5	0.783367	0.605567	0.162535
C_6	1.338336	1.338336	1.338336	1.742882	1.281388	0.5	0.672233	0.161323
C_7	1.685934	1.395284	1.281388	2.147428	1.79983	1.685934	0.5	0.210576

Table 9. Interdependency matrix of the main criteria related to C_7 Operational Risk.

Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7	Local Weight
C_1	0.5	0.8167	0.605567	0.6389	0.750033	0.605567	0.527767	0.094102
C_2	1.22444	0.5	0.672233	0.6389	0.750033	0.494433	0.7167	0.103519
C_3	1.79983	1.685934	0.5	0.783367	0.6389	0.750033	0.672233	0.133783
C_4	1.685934	1.281388	1.281388	0.5	0.672233	0.6389	0.494433	0.126593
C_5	1.338336	1.742882	1.742882	1.685934	0.5	0.783367	0.605567	0.162214
C_6	1.338336	1.338336	1.338336	1.742882	1.281388	0.5	0.8167	0.165547
C_7	2.147428	1.395284	1.685934	2.204376	1.79983	1.22444	0.5	0.214242

Table 10. The comparative impact of seven criteria and rank of risks.

Criteria	Weights of criteria	Rank
C_1	0.092312	7
C_2	0.105421	6
C_3	0.127567	4
C_4	0.122383	5
C_5	0.169425	3
C_6	0.174767	2
C_7	0.208124	1

The results of the DEMATEL method discuss as follow. First, build the direct relation matrix in step 7. Then applying Eqs. (5,6) for normalizing the direct relation matrix. Table 11. Present the normalized matrix for the criteria. Then use the Matlab code for obtaining the total relation matrix in Table 12. Then the sum of rows and columns in Table 13. The results of the cause diagram show that C_3 Commodity risk had the greatest impact and Operational risk C_7 had a lesser impact. Fig 6. Show the cause diagram.

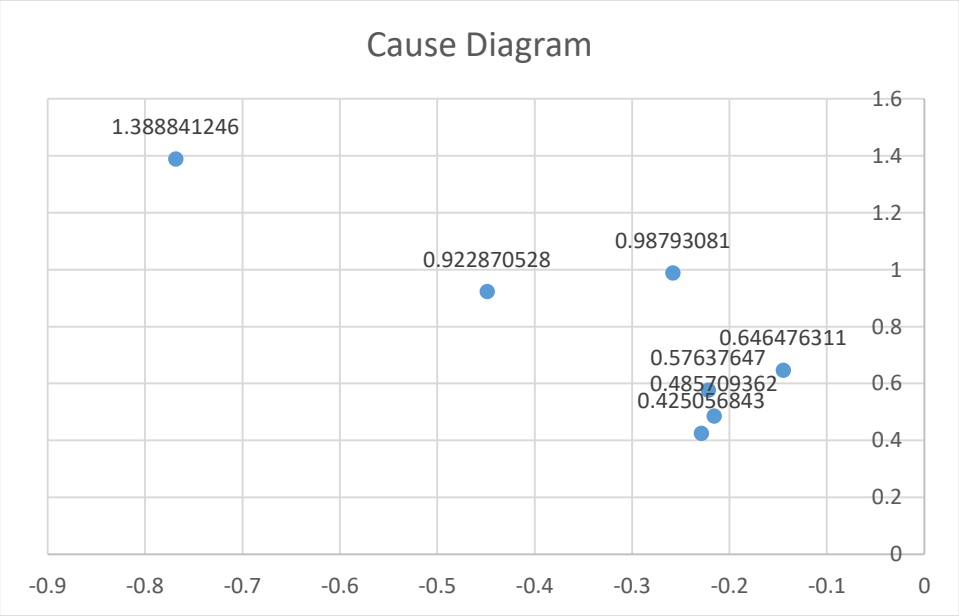

Fig 6. The cause diagram by DEMATEL method.

Table 11. The normalized decision matrix for main criteria.

Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7
C_1	0.052476	0.082215	0.05539	0.070552	0.078717	0.051891	0.051891
C_2	0.134483	0.052476	0.067053	0.075218	0.051891	0.070552	0.078717
C_3	0.225375	0.182917	0.052476	0.085714	0.051891	0.078717	0.040228
C_4	0.134483	0.128506	0.128506	0.052476	0.078717	0.05539	0.078717
C_5	0.273809	0.231352	0.231352	0.14046	0.052476	0.070552	0.082215
C_6	0.134483	0.14046	0.14046	0.225375	0.176941	0.052476	0.082215
C_7	0.231352	0.14046	0.273809	0.14046	0.134483	0.134483	0.052476

Table 12. The total relation matrix.

Main Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7
C_1	-0.02384	0.0216	-0.00471	0.022175	0.041601	0.019845	0.021454
C_2	0.053234	-0.01624	-0.00057	0.017843	0.003389	0.032477	0.044792
C_3	0.131494	0.105464	-0.02012	0.016379	-0.00687	0.032037	-0.00757
	0.026911	0.043409	0.051409	-0.01504	0.026146	0.007276	0.037166
C_5	0.114421	0.102734	0.125921	0.04172	-0.03044	-0.00443	0.015003
C_6	-0.02795	0.007524	0.016442	0.133228	0.10441	-0.01425	0.017613
C_7	0.052674	-0.01144	0.154788	0.026163	0.045809	0.059633	-0.01752

Table 13. The sum of rows and columns.

Main Criteria	X	Y	X-Y	X+Y
C_1	0.098121	0.326936	-0.22882	0.425057
C_2	0.13493	0.350779	-0.21585	0.485709
C_3	0.25081	0.395666	-0.14486	0.646476
C_4	0.177274	0.399102	-0.22183	0.576376
C_5	0.36493	0.623001	-0.25807	0.987931
C_6	0.237016	0.685854	-0.44884	0.922871

C_7	0.310103	1.078739	-0.76864	1.388841

The results of board composition show the weights of six factors. The Board size F_5 is the highest weights in the five factors with value 0.245594, then the Audit Committee meetings F_4 with value 0.210658, then Independent directors F_3 = 0.21379, then Board qualification F_2= 0.17068, then the lowest factor is Gender F_1=0.15277. Table 14. Show the decision matrix between criteria and others. Table 15 show the weights and rank of six factors.

With the DEMATEL method show that the F_5 board size has high impact on VRD and the F_1 Gender has lowest impact on VRD. Table 16. Show the sum or rows and columns and rank of impact on VRD. Fig 7. Show the cause diagram of board composition.

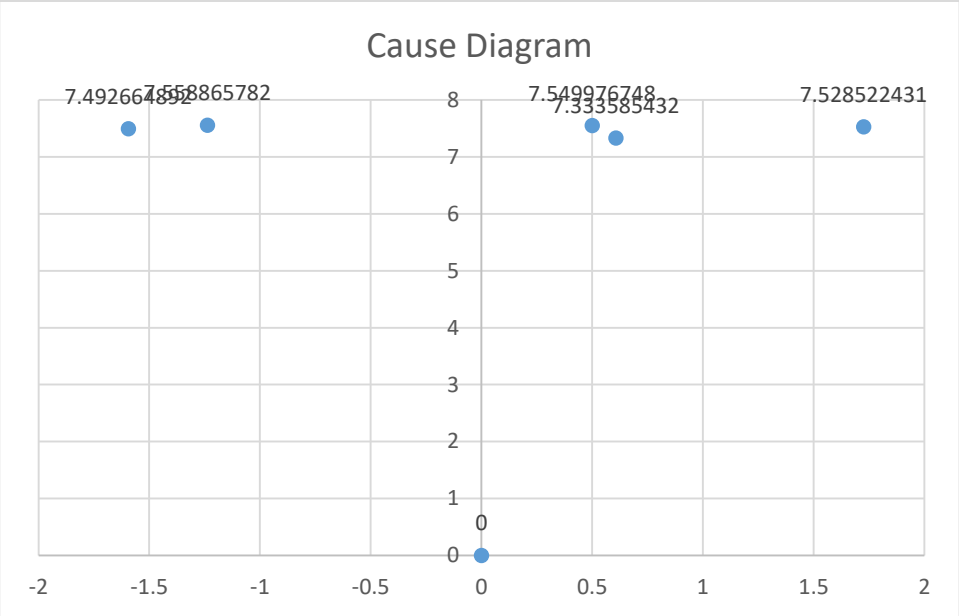

Fig 7. Cause Diagram of Six Factors of board composition.

Table 14. The combined pairwise comparison of six factors.

Criteria	F_1	F_2	F_3	F_4	F_5
F_1	0.5	0.783367	0.750033	0.8167	0.7167
F_2	1.281388	0.5	0.6389	0.7167	0.783367
F_3	1.338336	1.742882	0.5	0.8167	0.750033
F_4	1.281388	1.22444	1.22444	0.5	0.750033
F_5	1.281388	1.338336	1.338336	1.338336	0.5

Table 15. The weights and rank of six factor of board composition on VRD.

Six Factors	Weights of Six Factors	Rank
F_1	0.159277	5
F_2	0.17068	4
F_3	0.21379	2
F_4	0.210658	3
F_5	0.245594	1

Table 16. The sum of rows and columns of board composition for six factor.

Six Factors	X	Y	X-Y	X+Y
F_1	2.949194	4.543471	-1.59428	7.492665
F_2	3.160792	4.398073	-1.23728	7.558866
F_3	4.024743	3.525234	0.499509	7.549977
F_4	3.97023	3.363355	0.606875	7.333585
F_5	4.626848	2.901674	1.725174	7.528522

5. Analysis of VRD

The dependent variable for the study was voluntary risk disclosure. A disclosure index, which is coded as VRD, was developed based on a seven criteria. The regression equation that was used to test the hypothesis was of the form:

$$VRD = \beta_0 + \beta_1 BSIZE + \beta_2 BQUAL + \beta_3 INDEP + \beta_4 ACMEET + \beta_5 GENDER + \beta_6 IFRS + e$$

Where

VRD: Voluntary risk disclosure,

BSIZE: Board size,

BQUAL: Board qualification

INDEP: Independent directors

ACMEET: Audit committee meetings

GENDER: Number of females on the board

IFRS: International Financial Reporting Standards

The outputs of the multiple regression analysis indicate the regression model was statistically significant: F (5, 74) 3.542 and $p < 0.05$. The R2 was 0.193, which means that 19.3% of the variance in

the level of voluntary risk disclosure was explained by the five independent variables. Independent variables has an impact on the voluntary risk disclosure practices by the Saudi listed corporates.

6. Conclusions

This paper study the voluntary risk disclosure in companies of Saudi Arabian. This paper proposes seven criteria. The neutrosophic sets are used to deal with uncertainty. The MCDM method is used in this paper like ANP and DEMATEL methods. ANP is used to calculate the weights of main and sub-criteria. DEMATEL method is used to assess and show the impact of voluntary risk disclosure. The main results show that the Operational risks are the highest impact and reputation risk is the lowest impact. Future work can use other MCDM methods like TOPSIS and VIKOR.

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